CLAIMS

What is claimed is:

1. A method for assembling an electrochemical subassembly comprising:

a) adhesively bonding an anode side of a membrane and electrode assembly to an anode side of a bipolar grid; and

b) adhesively bonding a cathode side of the membrane and electrode assembly to a cathode side of an additional bipolar grid, wherein an adhesive provides a fluid-tight seal between the grids and the membrane and electrode assembly.

2. The method of claim 1, further comprising

c) adhesively bonding an anode side of an additional membrane and electrode assembly to an anode side of the additional bipolar grid;

d) adhesively bonding a cathode side of the additional membrane and electrode assembly to a cathode side of an additional bipolar plate; and

e) repeating steps c and d until a pre-determined number of membrane and electrode assemblies have been adhesively bonded.

3. The method of claim 1, wherein the membrane and electrode assembly comprises a solid polymer electrolyte membrane having a cathode electrode formed on a first side of the membrane and an anode electrode formed on a second side of the membrane.

4. The method of claim 3, wherein the solid electrolyte membrane is a material capable of conducting ions selected from single phase polymers, mixed phase polymers or matrix reinforced polymers.

5. The method of claim 4, wherein the ions conducted by the polymer are cations.

6. The method of claim 1, further comprising

dimensionally stabilizing a perimeter of the membrane and electrode assembly.

7. The method of claim 6, wherein the step of dimensionally stabilizing a perimeter further comprises:

converting a central portion of a sheet of PFSF polymer to an acid form;

forming an anode and a cathode on opposing sides of the central portion of the sheet.

8. The method of claim 6, wherein the membrane is initially fully protonated, the step of dimensionally stabilizing the perimeter further comprises:

converting the perimeter of the membrane to a tetra-alkyl ammonium form.

9. The method of claim 8, further comprising:

contacting the perimeter with an alcohol solution of a tetra-alkyl ammonium salt, wherein the tetra-alkyl ammonium is selected from symmetrical and asymmetrical structures.

10. The method of claim 9, wherein the tetra-alkyl ammonium salt is a hydroxide.

11. The method of claim 9, wherein the tetra-alkyl ammonium salt dissociates to a cation having a form $(NR'R''R'''R'''')^+$, wherein R', R'', R''', and R'''' are identical.

12. The method of claim 9, wherein the tetra-alkyl ammonium salt dissociates to a cation having a form $(NR'R''R'''R'''')^+$, wherein R' and R'' are identical and different from R''' and R''''.

13. The method of claim 9, wherein the tetra-alkyl ammonium salt dissociates to a cation having a form $(NR'R''R'''R'''')^{+}$, wherein R', R'', R''', R'''' are different from each other.

14. The method of claim 6, wherein the step of dimensionally stabilizing the perimeter further comprises:

converting the perimeter of the membrane to a polyvalent cationic form.

15. The method of claim 6, wherein the step of dimensionally stabilizing the perimeter further comprises:

contacting the perimeter with a basic solution of aluminum sulfate.

16. The method of claim 3, further comprising:

bonding an additional layer of a membrane to the perimeter on at least one side of the membrane and electrode assembly.

17. The method of claim 16, wherein the bonding is a process selected from hot pressing and applying an adhesive.

18. The method of claim 16, wherein the additional layer is dimensionally stabilized.

19. The method of claim 1, wherein the bonding perimeters of the bipolar grids are of material selected from metal, carbon, electronically conductive polymers, conductive polymer composites or insulating polymers.

20. The method of claim 1, wherein the adhesive is an adhesive type selected from reactively cured, thermoplastic, and cured by solvent loss.

21. The method of claim 1, wherein the adhesive is an epoxy having a hardness (Shore A) of between about 90 and about 70.

22. The method of claim 1, wherein the adhesive is an epoxy having a hardness (Shore A) of about 80.

23. A method for assembling an electrochemical stack subassembly comprising:

a) adhesively bonding an anode side of a membrane and electrode assembly to an anode side of a bipolar element; and

b) adhesively bonding a cathode side of the membrane and electrode assembly to a cathode side of an additional bipolar element, wherein an adhesive provides a fluid-tight seal between the bipolar element and the membrane and electrode assembly.

24. The method of claim 23, wherein the bipolar element is selected from a bipolar plate or a bipolar grid.

25. The method of claim 23, further comprising:

applying adhesive to a perimeter of a feature on the bipolar element , wherein the feature is selected from a flow field, a manifold, a channel, and combinations thereof.

26. The method of claim 23, further comprising:

c) adhesively bonding an anode side of an additional membrane and electrode assembly to an anode side of the other bipolar element;

d) adhesively bonding a cathode side of the additional membrane and electrode assembly to a cathode side of an additional bipolar element; and

e) repeating steps c and d until a pre-determined number of membrane and electrode assemblies have been adhesively bonded.

27. The method of claim 23, wherein the membrane and electrode assembly comprises a solid polymer electrolyte membrane having a cathode electrode formed on a first side of the membrane and an anode electrode formed on a second side of the membrane.

28. The method of claim 27, wherein the solid electrolyte membrane is a material capable of conducting ions selected from single phase polymers, mixed phase polymers or matrix reinforced polymers.

29. The method of claim 28, wherein the ions conducted by the polymer are cations.

30. The method of claim 23, further comprising:

dimensionally stabilizing a perimeter of the membrane and electrode assembly.

31. The method of claim 30, wherein the step of dimensionally stabilizing a perimeter further comprises:

converting a central portion of a sheet of PFSF polymer to an acid form;

forming an anode and a cathode on opposing sides of the central portion of the sheet.

32. The method of claim 30, wherein the membrane is initially fully protonated, the step of dimensionally stabilizing the perimeter further comprises:

converting the perimeter of the membrane to a tetra-alkyl ammonium form.

33. The method of claim 32, further comprising:

contacting the perimeter with an alcohol solution of a tetra-alkyl ammonium salt, wherein the tetra-alkyl ammonium is selected from symmetrical and asymmetrical structures.

34. The method of claim 33 where in the tetra-alkyl ammonium salt is a hydroxide.

35. The method of claim 33, wherein the tetra-alkyl ammonium salt dissociates to a cation having a form $(NR'R''R'''R'''')^+$, wherein R', R", R''', and R'''' are identical.

36. The method of claim 33, wherein the tetra-alkyl ammonium salt dissociates to a cation having a form $(NR'R''R'''R'''')^+$, wherein R' and R" are identical and different from R''' and R''''.

37. The method of claim 33, wherein the tetra-alkyl ammonium salt dissociates to a cation having a form $(NR'R''R'''R'''')^+$, wherein R', R", R''', R'''' are different from each other.

38. The method of claim 30, the step of dimensionally stabilizing the perimeter further comprises:

converting the perimeter of the membrane to a polyvalent cationic form.

39. The method of claim 30, the step of dimensionally stabilizing the perimeter further comprises:

contacting the perimeter with a basic solution of aluminum sulfate.

40. The method of claim 27, further comprising:

bonding an additional layer of a membrane to the perimeter of at least one side of the membrane and electrode assembly.

41. The method of claim 40, wherein the bonding is a process selected from hot pressing and applying an adhesive.

42. The method of claim 40, wherein the additional layer is dimensionally stabilized.

43. The method of claim 23, further comprising

adhesively bonding a final anode bipolar element spanning only an anode side of a membrane and electrode assembly;

adhesively bonding a final cathode bipolar element spanning only a cathode side of a membrane and electrode assembly.

44. The method of claim 23, wherein the bonding perimeters of the bipolar elements are of material selected from metal, carbon, electronically conductive polymers, conductive polymer composites or insulating polymers.

45. The method of claim 23, wherein the adhesive is an adhesive type selected from types consisting of reactively cured, thermoplastic, and cured by solvent loss.

46. The method of claim 23, wherein the adhesive is an epoxy having a harness (Shore A) of between about 90 and about 70.

47. The method of claim 23, wherein the adhesive is an epoxy having a hardness (Shore A) of about 80.

48. The method of claim 23, wherein the adhesive is a silicone material.

49. The method of claim 23, wherein the adhesive is a polyurethane.

50. The method of claim 23, wherein the adhesive is a thermoplastic selected from polyalkylenes, polyethylene containing copolymers, polypropylene, polypropylene containing copolymers, polyesters and polyarethanes.

51. A method for assembling an electrochemical cell stack comprising:

adhesively bonding components for subassemblies of an electrochemical cell stack; and

adhesively bonding the subassemblies needed for an electrochemical stack, wherein the components for the subassemblies are selected from bipolar plates, bipolar grids, membrane and electrode assemblies, cooling plates, heating plates, or combinations thereof.

52. The method of claim 51, further comprising:

storing the subassemblies.

53. The method of claim 51, wherein the subassemblies form at least one repeating unit within the electrochemical cell stack.

54. The method of claim 51, wherein an adhesive provides a seal for all fluids contacting the adhesive when the stack is in operation.

55. A subassembly for an electrochemical cell stack comprising:

a bipolar element;

a membrane and electrode assembly, wherein a perimeter of the membrane and electrode assembly is dimensionally stabilized;

an adhesive bond, wherein the adhesive bond provides a fluid-tight seal between the bipolar element and the membrane and electrode assembly.

56. The subassembly of claim 55, wherein the bipolar element is selected from a bipolar plate, a bipolar grid, a heating plate, a cooling plate, and combinations thereof.

57. The subassembly of claim 55, wherein the membrane and electrode assembly comprises:

a solid polymer electrolyte membrane;

a cathode electrode formed on a first side of the membrane; and

an anode electrode formed on a second side of the membrane.

58. The subassembly of claim 57, wherein the solid electrolyte membrane is a material capable of conducting ions selected from single phase polymers, mixed phase polymers or matrix reinforced polymers.

59. The subassembly of claim 57, wherein the solid polymer electrolyte membrane further comprises:

a perimeter of PFSF polymer;

a central portion of PFSF polymer converted to an acid form.

60. The subassembly of claim 55, wherein a perimeter of the membrane and electrode assembly is of a tetra-alkyl ammonium form.

61. The subassembly of claim 55, wherein a perimeter of the membrane and electrode assembly is of a polyvalent cationic form.

62. The subassembly of claim 55, further comprising an additional layer of a membrane to a perimeter on at least one side of the membrane and electrode assembly.

63. The subassembly of claim 62, wherein the additional layer is dimensionally stabilized.

64. The subassembly of claim 55, wherein the bonding perimeters of the bipolar element is made of material selected from metal, carbon, electronically conductive polymers, conductive polymer composites or insulating polymers.

65. The subassembly of claim 55, wherein the adhesive bond is formed by an adhesive type selected from reactively cured, thermoplastic, and cured by solvent loss.

66. The subassembly of claim 55, wherein the adhesive bond is formed by an epoxy having a hardness (Shore A) between about 90 and 70.

67. A method for assembling an electrochemical subassembly comprising:

a) adhesively bonding an anode side of a membrane and electrode assembly to an anode side of a bipolar element;

b) adhesively bonding a cathode side of the membrane and electrode assembly to a cathode side of an additional bipolar element, wherein the adhesive provides a fluid-tight seal between the bipolar element and the membrane and electrode assembly; and

c) using an epoxy having a hardness (Shore A) of between about 90 and 70 for adhesive bonding.

68. The method of claim 67, wherein the bipolar element is selected from a bipolar plate or a bipolar grid.

69. The method of claim 67, further comprising:

applying adhesive to a perimeter of a feature on the bipolar element , wherein the feature is selected from a flow field, a manifold, a channel, and combinations thereof.

70. The method of claim 67, further comprising:

d) adhesively bonding an anode side of an additional membrane and electrode assembly to an anode side of the other bipolar element;

e) adhesively bonding a cathode side of the additional membrane and electrode assembly to a cathode side of an additional bipolar element; and

e) repeating steps c through e until a pre-determined number of membrane and electrode assemblies have been adhesively bonded.

71. The method of claim 67, wherein the membrane and electrode assembly comprises a solid polymer electrolyte membrane having a cathode electrode formed on a first side of the membrane and an anode formed on a second side of the membrane.

72. The method of claim 71, wherein the solid electrolyte membrane is a material selected from single phase polymers, mixed phase polymers or matrix reinforced polymers.

73. The method of claim 71, wherein a perimeter of the membrane is dimensionally stabilized.

74. A subassembly for an electrochemical cell stack comprising:

a bipolar element;

a membrane and electrode assembly;

an adhesive bond, wherein the adhesive bond provides a fluid-tight seal between the bipolar element and the membrane and electrode assembly.

75. The subassembly of claim 74, wherein the bipolar element is selected from a bipolar plate, a bipolar grid, a heating plate, a cooling plate, and combinations thereof.

76. The subassembly of claim 74, wherein the membrane and electrode assembly comprises:

a solid polymer electrolyte membrane;

a cathode electrode formed on a first side of the membrane; and

an anode electrode formed on a second side of the membrane.

77. The subassembly of claim 76, wherein the solid electrolyte membrane is a material capable of conducting ions selected from single phase polymers, mixed phase polymers or matrix reinforced polymers.

78. The subassembly of claim 76, wherein a perimeter of the membrane and electrode assembly is dimensionally stabilized.

79. The subassembly of claim 76, wherein the solid polymer electrolyte membrane further comprises:

a perimeter of PFSF polymer;

a central portion of PFSF polymer converted to an acid form.

80. The subassembly of claim 78, wherein a perimeter of the membrane and electrode assembly is of a tetra-alkyl ammonium form.

81. The subassembly of claim 78, wherein a perimeter of the membrane and electrode assembly is of a polyvalent cationic form.

82. The subassembly of claim 74, further comprising an additional layer of a membrane to a perimeter on at least one side of the membrane and electrode assembly.

83. The subassembly of claim 82, wherein the additional layer is dimensionally stabilized.

84. The subassembly of claim 74, wherein the bonding perimeters of the bipolar element is made of material selected from metal, carbon, electronically conductive polymers, conductive polymer composites or insulating polymers.

85. The subassembly of claim 74, wherein the adhesive bond is formed by an adhesive type selected from reactively cured, thermoplastic, and cured by solvent loss.

86. The subassembly of claim 74, wherein the adhesive bond is formed by an epoxy having a hardness (Shore A) between about 90 and 70.